

A · G · A · V · E



Quarterly Magazine of the Desert Botanical Garden, Phoenix, Arizona

F A L L 1 9 8 7

A·G·A·V·E

VOLUME 2, NUMBER 4 / FALL 1987

BOARD OF TRUSTEES

OFFICERS

President, James Louden
President-Elect, Roger Davis
Secretary, Elizabeth Mitchem
Treasurer, Darel McIntyre

Elizabeth Alpert	Darryl McConaghie
John Augustine	Robert Mueller
Vikie Bone	Wm. Howard O'Brien
Dennis Christensen	L. Roy Papp
H. Clifton Douglas	John C. Pritzlaff
Kate Ellison	Steven Robson
Alice Feffer	N. Joel Smith
Donna Humphrey Fleischer	Milton Sommerfeld
Robert Gallaher	Virginia Ullman
Morgan Gust	Nancy White
Andrew Laubmeier	Jack Whiteman
Mary Ann McClennen	Rebecca Whitney
Cindy McCain	Bernadette Wolfswinkel

Administration

Executive Director, Robert G. Breunig, Ph.D.
Assistant Director for Research/Collections,
Gary P. Nabhan, Ph.D.
Comptroller, Jan Moats
Executive Secretary, Linda Schilling

Community Relations

Director, Sondra Mesnik
Dianne Pitcher
Al Blair

Education

Director, Kathleen Paul
Ruth Greenhouse
Dyan Del Gaudio
Volunteer Coordinator, Lynne Bowenkamp

Research

Research Botanists, Allan D. Zimmerman, Ph.D.
Robert A. Bell, Ph.D.
Stan R. Szarek, Ph.D.
Research Assistant,
Mark Slater

Herbarium

Curator, Wendy C. Hodgson
Research Consultant, Rick Delameter

Collections

Data Base Manager, Victor Gass
Chief Horticulturist, Steve Priebe
Senior Horticulturists, Judy L. Mielke
Mary H. Wilkins
Horticulturist, Cesar Mazier

Library

Librarian, Jane Cole

Gift Shop

Manager, Joan Lundquist
Assistant Manager, Mary Ann Fox
Annie Jean Allison
Lynn Trainum
Donald Gonser
Edna Penwarden
Michael Murza

Maintenance

Supervisor, David Elliott
Douglas Mings
Security Guard, Dwayne Methfessel

Agave Magazine

Editor, Sondra Mesnik
Design, Daryll Mackey

ISSN 0735 0652

COVER: *Yucca elata* in flower at White Sands National Monument. Photo by Judy L. Mielke.

INTRODUCTION

by Judy L. Mielke

The Chihuahuan Desert is one of four North American deserts. Although it occurs primarily in Mexico, it does extend northward into New Mexico and Texas. The Big Bend region of Texas, as well as the area between the cities of Pecos and El Paso, are considered Chihuahuan Desert, as is the southern portion of New Mexico, including Lordsburg, Las Cruces, White Sands National Monument and Carlsbad Caverns National Park. Some scientists also consider parts of extreme southeastern Arizona to be in the Chihuahuan Desert, but others argue that desert vegetation has invaded former grassland that was overgrazed by livestock.

Two large mountain ranges in Mexico, the Sierra Madre Occidental on the west and the Sierra Madre Oriental on the east, create a "rain shadow" that traps most of the moisture coming from the Pacific Ocean and the Gulf of Mexico. The Rocky Mountains border the Chihuahuan Desert to the north, and the highlands of the Mexican Plateau mark the southern limit of this large desert, which is almost the size of the state of California.

The states of Coahuila, Durango, Zacatecas and San Luis Potosi also contain considerable areas of Chihuahuan Desert vegetation, and smaller portions of Tamaulipas and Nuevo Leon are classified as desert.

The climate is hot in the summer and cool in the winter, when nighttime temperatures frequently drop below freezing. Snow is not uncommon, but it never remains on the ground for long. Most of the precipitation comes with the summer monsoons, although some rain falls in December and January. Total rainfall varies from 7.8 inches per year

to almost 12 inches, which compares roughly with the Sonoran Desert.

The Chihuahuan Desert is an area of high elevations, averaging about 3,500-4,200 feet, but reaching as high as 6,500 feet in Mexico. The lowest areas are along the Rio Grande River, which separates Texas and Mexico.

Scattered mountains, bajadas and alluvial plains make up the topography of the Chihuahuan Desert. There are no rivers to drain the southern portion of this desert, so runoff collects in large, enclosed basins called playas. These shallow lakes may persist for days or even weeks but when the water does evaporate, it leaves the soil very alkaline. Only a few plants, known as halophytes (salt-lovers),



A view of the Chihuahuan Desert: the Rosillos Mountains in Texas. Photo by Judy L. Mielke.

can grow in the playas.

Most of the Chihuahuan Desert is dominated by soils of calcareous origin, including gypsum and limestone. The dazzling white dunes of White Sands National Monument in New Mexico are actually gypsum dunes.

The gypsum-derived soils are one physical factor that encourages *endemism* — the evolution of plant species unique to that region. About one-third of the Chihuahuan Desert flora is endemic, found nowhere else in the world.

This special issue of *Agave* is an acknowledgment and appreciation of the unique resources contributed by the Chihuahuan Desert — ornamentals, landscape plants, foods, medicines and fibers among them. But as Dr. Pinkava points out in his article, even those Chihuahuan endemics not now considered useful are in urgent need of further study and conservation.

We hope that this issue will stimulate further inquiry, appreciation and protection.

THE CHIHUAHUAN DESERT

by Dr. Allan D. Zimmerman

*M*ost *Agave* subscribers are Sonoran Desert people. They may ask: "Why bother about some other desert? Don't we have our hands full just trying to educate people about their own Sonoran Desert? What's different about that other desert, anyway?" Well, let's put "that other desert" into some sort of perspective.

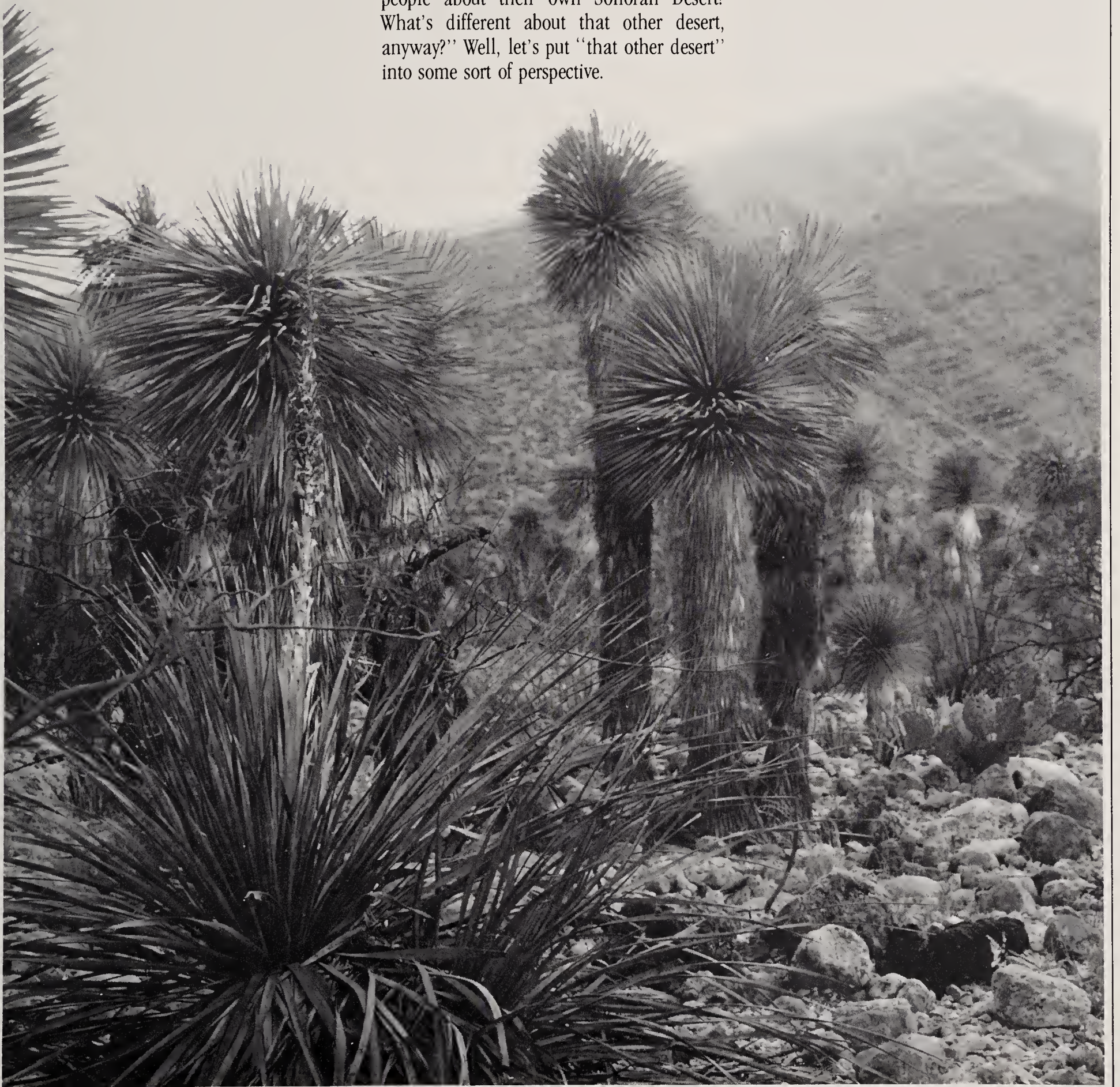


Photo by Dr. Donald J. Pinkava.



Dasylirion leiophyllum, a Chihuahuan variety of desert spoon. Photo by Judy L. Mielke.

First of all, the Sonoran and Chihuahuan deserts have a world of things in common. Wide vistas. Mesquite. Salt-bush. Ocotillo. Night-blooming cereus plants hidden in a few of the bushes. All sorts of desert reptiles. Roadrunners. Swainson's hawk in summer, Northern Harrier in winter. Adobe buildings. The Spanish language. Creosote bushes, giving the land a distinctive, pleasant, brisk smell after a warm rain.

I'm a biologist, poised to move to Phoenix from western Texas, where I've spent the past two years researching the cacti for *Chihuahuan Desert Flora*. As I think back to the Chihuahuan Desert this fall, from the lush, saguaro-filled grounds of the Desert Botanical Garden, I anticipate missing certain of the things that make the Chihuahuan Desert distinctive. The abundance and diversity of native grasses, forming arid prairies in all but the lowest and hottest and most severely overgrazed places, stands out in my memory. I'll miss the layer-cake appearance of each of the hundred gray

limestone mesas and mountains where I've done much of my research. I'll miss the pleasantly cool summers of this relatively high plateau! Because I am a botanist, I'll miss the profusion of weird Chihuahuan Desert cacti underfoot, too.

This desert supports an unusually diverse and bewildering assortment of odd little pincushion cacti and related genera, many of which are tiny but unique plants looking remarkably like golf balls, stones or echinoderms. The usual prickly-pears and chollas are represented, too, but there are no giant columnar cacti outside of one small region on the fringe of the tropics. Barrel cacti are conspicuous in certain special regions in the Mexican part of the desert, but inconspicuous north of the Rio Grande. In the Texas part of the desert, roughly sixty-four species of cacti are known (nearly as many as in the whole state of Arizona.)

The other 130-or-so species of Chihuahuan Desert cacti are confined to Mexico, where the



A view of the Chihuahuan Desert near Alpine, Texas. Photo by Judy L. Mielke.

whole flora is poorly inventoried. It is very difficult for professional botanists to identify most of these cacti. The published literature pertaining to them is copiously illustrated but piecemeal — scattered in hundreds of journal articles and esoteric books, many of them in either Spanish or German. Some of those species are barely known to science. No herbarium has a complete set of specimens of Chihuahuan Desert cacti. To all but a dedicated specialist, most such cacti are little more than unfamiliar Latin names on old lists of Mexican plants, generally accompanied by brief written descriptions that seldom are detailed enough for us to understand exactly how the plants are supposed to look or exactly where they were discovered.

When *Chihuahuan Desert Flora* is in print, all of us will be able to identify plants that currently have to be sent off to a hundred different specialists. Naturalists in the Chihuahuan Desert are understandably impatient to see the *Flora*, and other scientific publi-

cations about the Chihuahuan Desert, in print.

So, belatedly or not, the Chihuahuan Desert finally is getting some of the attention it deserves — although it remains an uphill battle. If you've lived for a few years in Phoenix or Tucson, you've probably noticed the bumper sticker "Sonoran Desert/love it or leave it." But there is no corresponding Chihuahuan Desert sticker. Perhaps that's because relatively few people have "discovered" the Chihuahuan Desert. As exemplified by this issue of *Agave*, most of the information about the Chihuahuan Desert is written by and for people who dwell outside it. Still, we are making a start. Tell your friends about the Chihuahuan Desert.

Dr. Allan D. Zimmerman, a distinguished research botanist, is the newest member of the Desert Botanical Garden staff. He was most recently associated with the Chihuahuan Desert Research Institute in Alpine, Texas.



Photo by Judy L. Mielke.



The Chihuahuan Desert supports an unusually diverse plant community. Photo by Judy L. Mielke.

Bringing the Chihuahuan Desert to the Garden

by Judy L. Mielke

Visitors to the Desert Botanical Garden will soon be able to see a small slice of the Chihuahuan Desert recreated in an area just west of the new exhibit trail, *Plants and People of the Sonoran Desert*.

Recently completed plans for the Garden's Chihuahuan Desert Section call for the addition of more than 1,200 plants to this area. Our goal is to replicate three of the most common vegetation associations of the Chihuahuan Desert. The plant communities are among those described in a paper by James Henrickson and Marshall C. Johnson, *Vegetation and Community Types of the Chihuahuan Desert*, which defines eight different desert plant communities and the dominant plants that occur in each. We have selected three of those communities to duplicate: Chihuahuan Desert Scrub, Lechuguilla Scrub and Yucca Woodland.

Roughly seventy percent of the total Chihuahuan Desert area is classified as

Chihuahuan Desert Scrub so, proportionately, the largest area of our exhibit will be established with this vegetation type. It is characterized by creosote bush (*Larrea tridentata*), tar bush (*Flourensia cernua*), mariola (*Parthenium incanum*), other small shrubs, small cacti and rosette-type succulents.

Lechuguilla Scrub includes many of these same plant species plus a much greater abundance of *Agave lechuguilla*, a relatively small, slender-leaved agave that spreads by rhizomes, forming dense stands.

The third vegetation type that we will be representing in the Garden's Chihuahuan Desert Section is Yucca Woodland. Large, arborescent (tree-type) yuccas are the dominant plants in these areas, co-occurring with desert spoon (*Dasyllirion leiophyllum*), as well as other rosette-type succulents and shrubs.

The Chihuahuan Desert Section of the Garden had been designated as such about ten years ago but progress has been slow and

somewhat sporadic. Now that a planting plan has been developed, work should proceed more rapidly. The plan was presented to experts at the Chihuahuan Desert Research Institute in Alpine, Texas last April. Their encouragement was the "go ahead" to begin planting.

Establishment actually began in the fall of 1986 when we started to remove many of the non-Chihuahuan plants. Seven large saguaros were relocated to the saguaro forest habitat of *Plants and People of the Sonoran Desert*. Two mature trees, a blue palo verde and a South American mesquite, were also removed from this section and replanted in other areas of the Garden. Several organ pipe cactus and numerous small cacti such as hedgehog, barrel and fishhook pincushion cacti were transplanted to areas on the Arizona Native Plant Trail. Bur-sage (*Ambrosia deltoidea*) plants represent the last Sonoran Desert plants that remain in the Chihuahuan Section. These won't be moved until we have acquired other plants to take their place.

In early June, our volunteer Horticulture Aides helped put in 41 small guayule (*Parthenium argenteum*) plants. Some were lost to transplant shock and predation by rodents but the ones that remain are strong and well-established. A few are even blooming already. Planting activity will increase dramatically as the temperatures cool down this fall.

One of the biggest challenges that remains is acquiring the plant materials to complete the plan. Many of the species will have to be propagated from seed or field collected in the Chihuahuan Desert from salvage areas such as road construction projects or housing developments.

The results will be worth the effort, though, as the Desert Botanical Garden's new Chihuahuan Section helps visitors understand and appreciate the variety and complexity of desert plant communities through comparing Chihuahuan ecosystems with their Sonoran counterparts closer to home.



Unusual forms of cacti, such as this *Echinocereus stramineus*, are found in the Chihuahuan Desert where conditions are similar to those in the Sonoran Desert. Photo by Judy L. Mielke.

An Urgent Need for Preservation: CUATRO CIENEGAS

by Donald J. Pinkava, Ph.D.

Southeastward from atop Mt. Anteojo, one of the loftiest peaks in the Chihuahuan Desert, one has a panoramic view of the truly magnificent Bolson of Cuatro Cienegas ("Four Marshes"), which lies in central Coahuila at the eastern edge of the Chihuahuan Desert and about 270 air kilometers southeast of Big Bend National Park. Below is the town of Cuatro Cienegas de Carranza, along freshwater Rio Canon which flows between Sierra de la Manchaca and massive Sierra de la Madera, whose steep limestone cliffs tower to more than 2350 meters above the basin floor and are capped by a mixed conifer forest. To the east are Sierra San Vicente and Sierra de la Purisima; to the west and southwest, Sierra de Fragua. The low, outjutting tip of Sierra de San Marcos nearly bisects the *bolson*, or closed drainage basin, from the south. The railway roughly parallels the east-west roadways through the bolson from Puerto Salada to Puerto de Jora. Mexico Highway 30 extends southward 25 km. from Municipio Cuatro Cienegas, along the east flank of Sierra San Marcos, past Laguna Grande and its giant gypsum dunes to Puerto San Marcos, and then on toward San Pedro. Although it is now readily accessible by this highway, the Cuatro Cienegas region was among the last parts of the desert to be explored by naturalists.

This intermontane bolson is unique because of its varied aquatic features — lagunas, playas, rivers, subterranean tubes, thermal springs, artesian wells, *posos* (aquatic habitats), cienegas. These basin habitats, long land-locked until man built canals exiting water through Puerto Salada, support a very rich biota noted for its endemism.

The saline basin floor (called a *playa*) supports an extensive grassland, dominated by alkaline sacaton and salt grasses. Secondary succession, as a playa is colonized by vegetation, results in open stands of saltbushes (and mesquite where dunes or wetlands persist) before returning to a grassland.



*The steep limestone cliffs of the Sierra de la Madera in Cuatro Cienegas.
Photo by Dr. Donald J. Pinkava.*



The grassland is dotted with aquatic and semiaquatic habitats. An interesting series of vegetational changes may be witnessed indirectly by observing posos of varying ecological maturities. The newly formed poso has essentially the same flora as the surrounding basin grasslands. Its slumping banks are soon populated by sedges, additional grasses (*Phragmites*, *Spartina*) and associated wildflowers (*Polygala turgida*, *Cynanchum*, *Eustoma* and *Flaveria*). As the poso matures and enlarges, the number of species appears additive, for even in the most advanced stages the early invaders are still represented, though fewer. The mature poso contains such aquatics as water-lily, bladderwort, and macroalgae (*Chara*). The shores support many grasses, sedges and herbs, surrounded by trees and shrubs including mesquite, catclaw acacia, ash and black willow.

Gypsum salts blown from evaporated lakebeds form brilliant white dunes like those of the famous White Sands in New Mexico, yet known to relatively few people. These add relief to the otherwise relatively flat basin, and they support a unique biota. Active dunes up to six meters high encroach upon streams, posos, older dunes and the surrounding plains. Mesquite trees, often nearly buried in sand, catclaw acacia, yuccas, and others are important in stabilizing dunes. The stabilized dune with its grayish crust supports several gypsum-loving species, particularly some bizarre endemic composites — *Machaeranthera restiformis*, *M. gypsophila*, *Gaillardia gypsophila*, *Dyssodia gypsophila* and *Haploestes robusta*. Also present are ocotillo, Christmas Cholla, hedgehog cacti, moonpod, euphorbias and sandpaper plants.

A transition zone encircles the basin and its lagunas as an interrupted band of shrubs and trees. The small islands of vegetation consist of salt-tolerant shrubs, acacias and mesquite. The bajadas and lower mountain slopes have a rich and varied Chihuahuan Desert scrub flora. Characteristic is creosote bush with varying combinations of co-dominants — *Agave lecheguilla*, *A. falcata*, *Hechtia scariosa*, *Opuntia bradtiana* (a uniquely shaped, sprawling cactus), *Yucca rostrata*, *Jatropha dioica*, *Euphorbia anti-siphilitica* and *Selaginella lepidophylla*.

The poso, or aquatic habitat, supports such plants as bladderwort and water lily.

Photo by Dr. Donald J. Pinkava.

An active gypsum dune near Laguna Grande.

Photo by Dr. Donald J. Pinkava.



(resurrection plant). Many cacti are found in this zone — *Echinocactus horizonthalonius*, *Epithelantha micromeris*, *E. bokei*, *Ariocarpus fissuratus*, and *Echinocereus stramineus*.

Chaparral is widespread but best developed on northerly and easterly exposures of protected arroyos and canyons and near forests. Its often dense growth consists of oaks, heaths, scattered pines and numerous other shrubs and small trees. On higher moister slopes in deep canyons, chaparral grades into woodlands of oak, pinyons, junipers and several associated species including palms (*Brahea berlandieri*, which appears incongruous amidst the otherwise familiar-looking vegetation of this middle-altitude life zone).

The moist montane forests are best developed in the upper, north-facing canyons of the massive sierras. Canopy includes Douglas-fir, fir, pines and Arizona cypress. Below the understory of maples, oaks, and madrono is an often moss-covered floor with only scattered herbs and small shrubs.

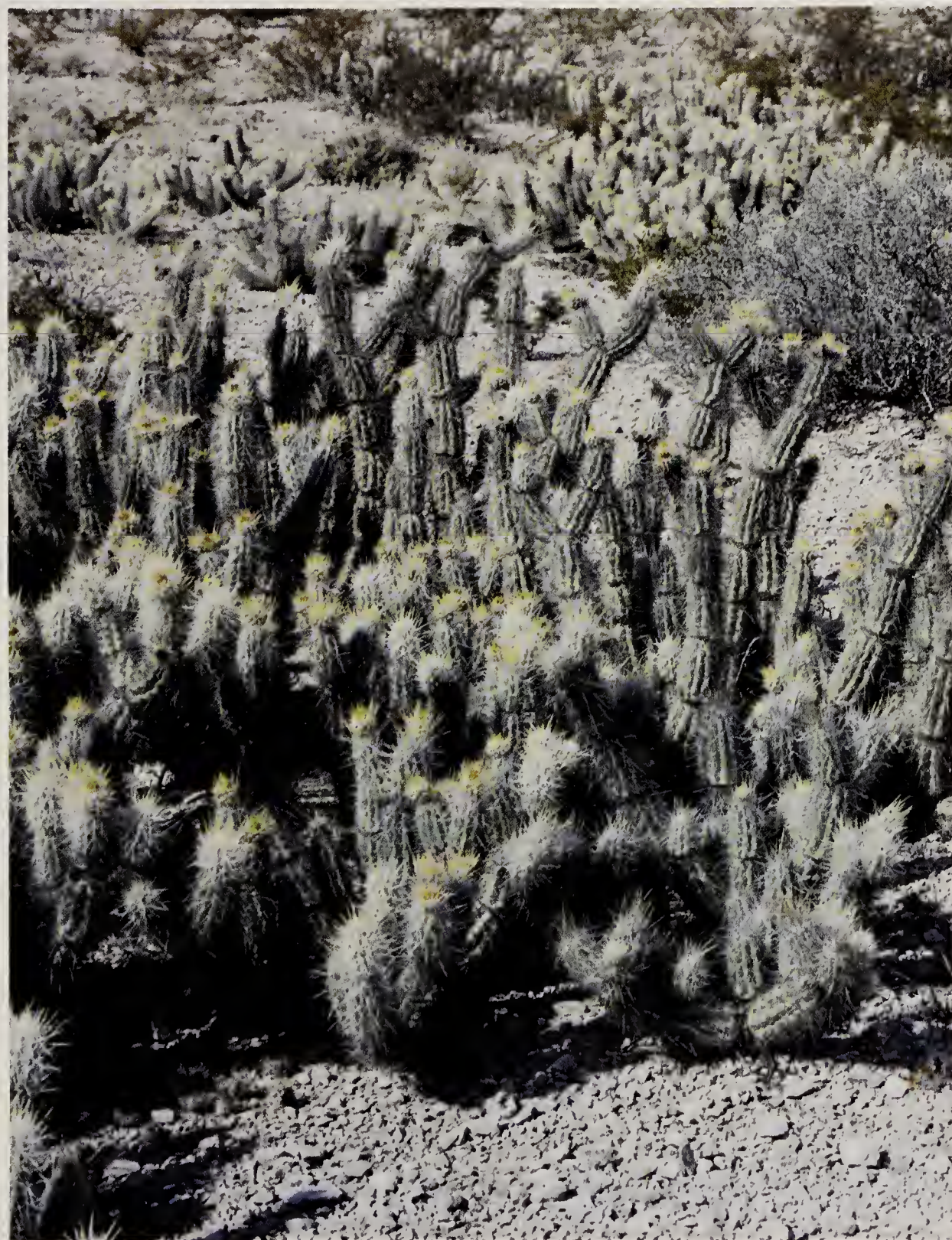
The known vascular flora for the Cuatro Cienegas region, an area of more than 2,000 square kilometers, consists of 879 taxa distributed among 860 species in 456 genera from 114 families. This flora, one of the most varied in the Chihuahuan Desert, contains 49 taxa which find their type locality in the region; of these 45 are currently recognized and 23 are endemic. An even greater number of taxa are found only here and in immediate adjacent areas. Endemism also occurs in the fauna, particularly in fishes, reptiles, snails and crustaceans.

Somehow, the uniqueness of Cuatro Cienegas must be communicated, especially to the people who live there, because even the small community that now exists is more than this limited area of marshland can withstand. Other threats to the ecosystem include goat and cattle grazing, canal construction, the mining of gypsum and the logging of conifers.

Those of us who have an opportunity to visit Cuatro Cienegas should make it clear that we are there not just to admire the scenery but to marvel at the biota. The great number of endemic plants and animals and the unique aquatic habitats create an urgent need to preserve at least a portion of Cuatro Cienegas before this important part of man's heritage is lost.

The upper forest canopy includes a population of Douglas fir and other conifers. Photo by Dr. Donald J. Pinkava.

A population of Grusonia bradtiana is a feature of this bajada in Cuatro Cienegas. Photo by Dr. Donald Pinkava.



THE DESERT'S FUTURE



It is hoped that the success of experimental modules will take pressure off the surrounding wildlands. This module of native crops, at La Saucedá, was designed by young researchers in Mexico's Forestry Service (INIFAP). Photos by Gary P. Nabhan.

by Gary Paul Nabhan, Ph.D.

One June morning at dawn, I climbed to the top of a Mexican mesa to look out over a puzzle of gypsum and limestone, of silt and salty soil, of ground-hugging cacti and sky-reaching yuccas. I scrambled up the slopes at La Saucedá, Coahuila, to scan the heart of the

Chihuahuan Desert. I could see before me, as I looked out over miles of desert scrub, the best and the worst of what humans can do to a fragile, moisture-limited environment.

First, the worst. In the distance, near a highway to the south, there was soil so denuded of its vegetative cover that even



Processing Agave lechuguilla fiber in Saltillo.

reforestation efforts had failed. From small towns alongside the highway, impoverished campesinos had removed much of the fuelwood, and most of the lechuguilla and candelilla — two desert succulents that offer economic products — for a twelve mile radius surrounding their homes (Arnoldo-Ortega, 1981). In the candelilla zone alone, 172,000 square kilometers are affected, where

reforestation and wise use have not kept pace with exploitation (Chaves-Pruneda, 1985). In the past, once these sources of income were gone, once the little grass within reach of goats had disappeared, most of these rural dwellers have found few options other than leaving for the cities.

But closer to La Saucedá, new options are now being put into practice. La Saucedá is the oldest range and forestry experiment station in Mexico, and for years, it has benefitted from the vision of Lorenzo J. Maldonado, one of Mexico's most inspiring desert scientists. On the station grounds, there is a "teaching garden" to make workers aware of rare cacti in the area that deserve protection; there are range recovery experiments, where grazing is minimized so that grasses and shrubs can be replenished; and there are demonstration plots of new desert crops fed by storm runoff.

And yet where I saw the reflection of the Chihuahuan Desert's future was in a modest-size social experiment, simply called "the integrated modules." In an area of less than 50 acres, the production from these modules would provide a Mexican family with the cash equivalent of Mexico's minimum annual wages, in addition to meeting all their nutritional needs, using only desert plants and local water sources. Rather than having to travel out twelve miles to pull up whole candelilla clumps to harvest, 20,000 of these *Euphorbia antispythitica* plants had been established on two and a half acres, and a scheme for sustainable yields has been devised. Nearly five hundred pounds of high quality wax could be derived from this planting each year, if properly managed. The U.S. currently imports a million dollars worth of candelilla wax a year for candles, chewing gums and polishes (Prescott-Allen and Prescott-Allen, 1987).

Another plot the same size was planted with *Agave lechuguilla*, a producer of durable fiber for brushes used in this country and in Europe. In addition, two other useful agaves covered 12 acres; prickly pears covered five; drought-adapted annual grains and beans, fed by runoff, were sown seasonally on another five; finally, 25 acres were filled with salt-tolerant shrubs and grasses for forage. These latter plantings meant that a family could obtain all the meat, milk and eggs they needed from the modules, *without having to graze the surrounding fragile desert*.

As if food and fiber weren't enough, the barns and corrals surrounding the modules were of homegrown materials — mesquite

posts with leafy ocotillo walls. Using Chihuahuan Desert natives and a few selected species from other arid zones, a family could potentially live a decent life powered by the sun and rain which fell on that land.

Several modules of this kind have now been established at La Saucedá and near La Ventana, another experiment station in the Sierra del Jimulco near Torreon, Coahuila. Established with the support of several rural development programs, they are currently being "homesteaded" by local families. Researchers are monitoring their production to see if a sustainable way of life is possible there without making over the entire environment into an artificial, subsidized oasis. The hope is that the success of the modules will take pressure off the surrounding wildlands long enough to allow for their ecological recovery.

Depending upon one's point of view, the useful plants of the Chihuahuan Desert can be seen as a blessing or a curse. Those who curse them point out that their mismanagement and overexploitation has led to severe desertification on hundreds of thousands of hectares. Once the abundant cover formerly provided by mesquite, lechuguilla, candelilla and guayule is eliminated, rarer plants are exposed and destroyed too. But those who study the useful products of Chihuahuan Desert natives hope that reforestation and development efforts which utilize these plants can reverse these negative trends. By transplanting native economic plants back into wildland vegetation — as they are doing with the modules near La Ventana — there is no need to bulldoze, burn or otherwise convert desert plant communities to make a living. Many of those "hidden" rarities can still exist on the same land that is contributing to the livelihood of the campesinos.

Since the summer of 1986, the Desert Botanical Garden has been coordinating a number of northern Mexican projects on desert plant resource conservation and development, under an agreement between the USDA Forest Service and Mexico's equivalent agency, INIFAP. With the support of the Agency for International Development office in the U.S. Embassy, we have been providing technical assistance to field projects in five states in the Chihuahuan Desert region: Coahuila, Durango, Tamaulipas, Chihuahua and San Luis Potosi. In addition, the young investigators involved in this project have been invited to the Garden for two training workshops this year, one in May, that included 24 participants, and another in October. The Desert Botanical

Garden staff has provided the Mexican resource scientists with useful information that they might not have otherwise encountered if this "hands-across-the-border" collaboration had not occurred.

Some highlights from those field projects illustrate how the Garden's enthusiasm for economic botany and useful plant conservation is being shared with others. In San Luis Potosi, we are assisting researchers at the CREZA field station in the propagation and design of parallel hedgerows of edible prickly pears that protect two high-value spice crops, wild oregano (*Lippia berlandieri*) and chiltepinies (*Capsicum annuum*). These hedgerows border fields of conventional crops, forming barriers to livestock entry. At the same time, they attract certain birds and mammals that are considered "beneficial wildlife" in the region, according to Dr. Eric Mellink. Thus, the *Opuntia streptacantha* hedgerows are generating new income, additional food products and wildlife habitat.

In Tamaulipas, two projects have been initiated. One concerns the propagation of rare cacti that are currently being depleted in the wild. By paying campesinos to gather seed, assist in propagation, and protect wild stands, the researchers hope to provide them with a source of income other than that derived from illicit collecting. The rapid propagation and legal sale of these plants will, we hope, diminish the pressure on remaining wild stands. The other Tamaulipas project has a focus on reforestation and harvesting efficiencies of *Agave lechuguilla*. The aim is to redirect the lechuguilla industry towards sustained yield management, reducing waste in the harvesting and processing of fiber for brushes and brooms.

In Coahuila, resource managers are attempting to improve the conversion of mesquite fuelwood to charcoal and use the labor and time savings as an incentive for better managing mesquite woodlands. The species being harvested along the Rio Grande is *Prosopis glandulosa*, which can readily regrow from basal shoots or side trunks if properly "coppiced." Yet as the mesquite charcoal industry has rapidly grown, more sophisticated management techniques have not kept pace with it. This project also involves ASU alumni currently working for Mexico's INIFAP.

In Durango and Coahuila, wild oregano is now being harvested on tens of thousands of acres of Chihuahuan Desert, and the market for this spice is greatly expanding. With a

recent FDA ban on European oreganos contaminated by the Chernobyl nuclear accident, Mexico's wild stands of *Lippia* species will certainly be providing more than a million dollars of exports to the U.S. annually. Yet little is known about the chemistry, ecology, or management of the Mexican *Lippias*, as opposed to the European *Origanums*. INEREB, Mexico's internationally-regarded applied ecology institute, is investigating the product chemistry of indigenous oreganos and the prospects of essential oil extraction for flavorings, perfumes and soap.

Above the true desert in the uplands of Chihuahua, Dr. Robert Bye and his students from Mexico City are propagating plants harvested by the Tarahumara Indians: medicinal plants, nutritious greens, and agaves. By establishing local nurseries to replenish wild populations there will be enough plants for local use and for vending to regional markets. Thus, these resource management projects can help indigenous peoples as well as indigenous plants.

A recent publication reported that the United States and Canada economies annually consume \$3.3 million in wild plant resources from the American deserts. However, these figures are based only on agave and yucca fiber, candelilla wax and oregano. The actual economic impact of all imports of desert plant materials and products is much greater than these figures indicate.

For example, guayule rubber from *Parthenium argentatum* has been imported to the present-day United States since prehistoric times, as a rubber ball found among Hohokam ruins attests. Over the decades, more than 68 million kilograms of rubber from this Chihuahuan Desert shrub have been imported to this country, and Mexican production is again on the upswing. Mexico's wildlands currently possess the equivalent of 300,000 metric tons of natural rubber in the form of this plant, and experimental plantations exist in several states (Lopez-Benitez, 1985).

Next, consider members of the agave family, in addition to the palma samandoca (*Yucca carnerosana*) and lechuguilla (*A. lechuguilla*) already mentioned. For thirty years, a factory in Saltillo has been a major producer of gunnysacks derived from *Yucca carnerosana* and brushes from *Agave* (Shelden 1980). This model has been extended to other agavaceous species, in particular, the grass-like *Nolinas*. More and more of the brooms found in this country are made from the fiber of *Nolina microcarpa* and *N. texana*, called

palmilla by their Mexican harvesters. On Chihuahuan Desert margins in Arizona, Sonora, New Mexico and Chihuahua, these species form the basis of a multi-million dollar cottage industry (Nabhan and Burns, 1985). Between 2,990 and 4,200 metric tons of *Nolina* leaves are harvested each year,



Wild oregano, *Lippia berlandieri*, is a high value spice crop. Photo by Gary P. Nabhan.

primarily on the northeastern upland limits of the Chihuahuan region.

Mesquite is also a multi-million dollar export into the U.S., despite its occurrence on hundreds of thousands of acres in the southwest. It comes to this side of the border in the form of high-priced furniture, charcoal bricks, fuelwood and handicrafts. Surprisingly, however, the Mexican sales value of the pods as cattle feed has long surpassed that of all wood products combined! Fresh prickly pear, or *tunas*, are now flown out of the drylands of Mexico to U.S. grocery stores on a regular basis, selling for as much as \$.80 to

\$1.00 per fruit! Other *Opuntia* species are used to make a fruit leather called *queso de tuna*, sold in attractive packages to U.S. tourists in San Luis Potosi and Nuevo Leon. At the same roadside marketplaces, considerable quantities of wild chiles are sold, in bottles of vinegar or as a dried spice.

use of peyote, has placed tremendous pressures on wild populations and has caused local extirpation of this resource. Both overharvesting for illegal use and land conversion are threatening peyote's long-term survival in several areas of Texas, Coahuila, San Luis Potosi, and Queretaro.



The market for wild oregano has been expanding since the FDA banned European oreganos contaminated by the Chernobyl nuclear accident. Photo by Gary P. Nabhan.

Perhaps the most unique product that the Chihuahuan Desert offers is one that is usually exported illicitly — peyote. Since prehistoric times, this plant has been traded out of the Chihuahuan Desert proper, into Mesoamerica, the Sierra Madre Occidental and perhaps into the Southwest. It is likely that trade networks took massive quantities of this hallucinogenic plant to the Aztec elite in the past. Today, more than a quarter of a million Americans, largely of Indian ancestry, participate in the peyote cult of the Native American Church (Anderson, 1985). This use, as well as the unsanctioned, non-religious or “recreational”

Peyote is just one example of the many Chihuahuan Desert plants which escape official economic statistics, but nevertheless contribute to the cultures of our continent. Cactus sales in this country account for \$33 million a year over and above illicit sales. It is unclear whether all of these resources will ever be accounted for, at least as far as global economic summaries are concerned. Either way, it is hoped that these hardy, beneficial desert plants will be better managed and conserved in their natural ecosystems for the study, use and inspiration of future generations. ■



Yucca torreyi, commonly called shag yucca, grows to ten feet high and bears a cluster of creamy white flowers in spring. Photo by Judy L. Mielke.



Agave neomexicana bears a striking resemblance to its Sonoran Desert counterparts. These rosette-type succulents make striking accent plants for landscapes. Photo by Judy L. Mielke.

by Judy L. Mielke

It is a challenge to landscape in the desert. Heat, intense sunlight, drying winds and winter cold take their toll on all but the hardiest of plants. If you're searching for well-adapted plants to use in landscaping, look first to the natives. Over thousands of years they have evolved ways to deal with the climate and geology of the Sonoran Desert.

Another rich source of plant materials for landscaping is the Chihuahuan Desert, our neighbor to the southeast. The climate there is similar to ours — not much rain, hot summers and even colder winters than the Sonoran Desert. Snow is not uncommon, although it usually doesn't stay for long.

The Sonoran and Chihuahuan Deserts have several plants in common: creosote bush, mesquite and ocotillo are just three examples. Other plants are unique to the Chihuahuan Desert. One count puts the total number of plant species in this desert at about 2,800, with more than one-third or about 1,000, as being endemic (native or confined to a certain area).

Chihuahuan Desert plants can add variety to our landscapes while retaining a distinct Southwestern look. Many of the Chihuahuan Desert shrubs have the same fine-textured appearance and muted foliage coloration as Sonoran Desert plants. The unusual forms of cacti and rosette-type succulents such as yuccas, which make the Sonoran Desert so interesting are also found in the Chihuahuan Desert.

At least one Chihuahuan Desert landscape plant should be familiar to most Southwesterners. Texas ranger, or barometer bush (*Leucophyllum frutescens*), which bursts into lavender bloom following summer rains is a silvery leaved shrub that reaches five feet in height and at least that in width.

Other variations on Texas ranger have been

A Rich Source for Landscape Plants

developed by plant breeders. *Leucophyllum frutescens* "Compacta" is a smaller version of the species, three to four feet tall and wide. *L. frutescens* "White Cloud" has white flowers, rather than lavender, and *L. frutescens* "Green Cloud" has light-to-medium-green foliage.

Leucophyllums are sometimes called cenizo, which means "ash" in Spanish. A variety of *Leucophyllum candidum*, trademarked "Silver Cloud" by Texas A & M University, certainly lives up to that common name. The silvery foliage provides a striking contrast to the dark purple flowers. This shrub grows to four feet high and as wide.

Chihuahuan Desert sage (*Leucophyllum laevigatum*) has fragrant, bluish-lavender flowers that bloom off and on throughout the summer. The leaves are green and a little smaller than Texas ranger's but the overall plant size is about the same.

Another attractive shrub that hails from the Chihuahuan Desert is *Buddleia marrubifolia*, butterfly bush. The silvery-gray foliage is dotted with round, three-quarter-inch clusters of orange flowers in spring and fall. Butterfly bush has a rounded shape, three feet high and wide.

The magenta flowers of Texas red sage (*Salvia greggii*) provide a bright splash of color in the landscape. This small shrub (to 1½ feet high) blooms primarily in the spring and fall. If you brush against it, the foliage releases a pleasant, minty fragrance.

Mealy cup sage (*Salvia farinacea*) produces spikes of bright blue flowers atop a foot-high mound of green foliage. It is treated as an annual in colder climates, but here in the desert it lives for several years.

In February and March, the purple wisteria-like flowers of *Sophora secundiflora*, commonly called Texas mountain laurel or mescal bean, fill the air with a fragrance like grape soda. Another attribute of this plant is the glossy, evergreen foliage. Texas mountain

laurel grows slowly into a large shrub or small tree, about ten feet high and six feet across.

For a dash of summer color in the landscape, plant *Cassia wislizenii*. Delicate, deep green leaves are topped by clusters of yellow flowers, similar to the Australian Cassias that bloom here in the spring. The cold-deciduous *Cassia wislizenii*, which will reach ten feet in height and eight feet in width, should be planted with other evergreen plants to camouflage its winter bareness.

Trailing smoke bush, *Dalea greggii*, is an excellent groundcover for use in southwestern landscapes. It has delicate, silvery foliage that can spread to a diameter of five feet or more, since the stems root wherever they come in contact with soil. Round clusters of purple flowers bloom in the spring.

The Chihuahuan Desert is generally lacking in large trees. Though mesquite are abundant, they usually take the form of large shrubs. One medium-sized tree from the Chihuahuan Desert that is becoming more common in landscapes is the Texas ebony, *Pithecellobium flexicaule*. Gray bark and deep green, evergreen foliage combine in a handsome plant that grows slowly to about 15 feet high and 10 feet wide. Cream-colored, fragrant flowers appear off and on throughout the warmer months, followed by large, brown woody pods, which are in themselves decorative.

The zig-zaggy, densely foliated branches of *Acacia schaffneri* explain its common name, twisted acacia. This tree can reach 20 feet in height and 15 feet across. It becomes deciduous in harsh winters and produces golden, ball-shaped flowers in spring, after the new foliage appears.

Several Chihuahuan species of *Yucca* are suitable for landscape use. *Yucca torreyi*, called shag yucca because the lower leaves look shaggy, can reach ten feet high. It normally is multi-branched, with a large cluster of creamy-white flowers appearing at the top of each branch in springtime.

Yucca carnerosana is another stout-looking plant with broad, sword-shaped leaves radiating from a thick trunk. It grows to a height of 18 feet, and its cluster of creamy flowers is borne on a stalk well above the leaves.

Yucca rostrata grows to 15 feet high with slender leaves on a multi-stemmed trunk. The flower cluster can reach over two feet in length.

Agave victoriae-reginae has long been a favorite with collectors because of its compact, decorative rosette. Several of these foot-high plants with white-margined leaves would create a striking accent for the landscape.

The blue-green rosette of *Agave scabra* can reach three feet high. It, too, would make a fine specimen plant.

The Chihuahuan Desert has a desert spoon very similar to the Sonoran Desert species (*Dasyllirion wheeleri*). *Dasyllirion leiophyllum* reaches four feet in height and width, and has the same slender toothed leaves and tall flowering plume borne in the spring.

Red yucca (*Hesperaloe parviflora*) is neither a yucca nor an aloe, as the names imply, but it is a very attractive plant for landscapes. The narrow, arching leaves form a clump up to three feet high and wide. Hummingbirds are attracted to the stalks of pink flowers that bloom in spring and summer.

The planting procedure for Chihuahuan Desert natives is the same as for the other desert plants: dig a large hole, roughly twice the size of the container, mix some organic matter or mulch with the soil taken out of the hole, position the plant at the same level that it was growing in the container, refill the native soil/mulch mix around the rootball, and water deeply.

Because Chihuahuan Desert plants are well suited to conditions here in the Sonoran Desert, they shouldn't need any pampering once they're established.



**DESERT
BOTANICAL
GARDEN**

1201 N. Galvin Parkway
Phoenix, AZ 85008

NONPROFIT ORG.
U. S. POSTAGE
PAID
PHOENIX, ARIZONA
PERMIT NO. 1269